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AD NUMBER

AD335648

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AUTHORITY

USNOL ltr, 29 Aug 1974; USNOL ltr, 29 Nov 1974

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NOLTR 61-13

U. S. NAVAL ORDNANCE LABORATORY
NAVORD AND NAVWEPS REPORTS
PUBLISHED BY THE AEROBALLISTICS
RESEARCH AREA
1 JANUARY 1960 - 31 DECEMBER 1961

13 APRIL 1962

NOL

UNITED STATES NAVAL ORDNANCE LABORATORY, WHITE OAK, MARYLAND

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NOLTR 61-13

CONFIDENTIAL

U. S. NAVAL ORDNANCE LABORATORY NAVORD AND NAVWEPS REPORTS PUBLISHED BY THE AEROBALLISTICS RESEARCH AREA 1 January 1960 - 31 December 1961

Prepared by:

Helen A. Smith

Abstract: A list of all Naval Ordnance Laboratory NavOrd and NavWeps Reports published by the Aeroballistics Research Area from 1 January 1960 through 31 December 1961 is presented.

U. S. NAVAL ORDNANCE LABORATORY
White Oak, Silver Spring, Maryland

NOLTR 61-13 13 April 1962

This report contains an alphabetical listing, by authors, of NavOrd and NavWeps Reports that have been published by the Aeroballistic Research Area from 1 January 1960 through 31 December 1961. Brief abstracts are included.

The security classification of each report is given, and classification of the titles of classified reports are indicated as follows: U-Unclassified, C-Confidential, S-Secret.

W. D. COLEMAN
Captain, USN
Commander

R. E. WILSON
Associate Technical Director
(Aeroballistics)

U. S. NAVAL ORDNANCE LABORATORY
NAVORD AND NAVWEPS REPORTS
AND NOL TECHNICAL REPORTS
PUBLISHED BY THE
AEROBALLISTICS RESEARCH AREA
1 January 1960 - 31 December 1961

Butler, J. F.: Preliminary Trajectory Computations for Project Caleb. (C) NavOrd Report 6766. CONFIDENTIAL

Abstract: Preliminary results of six degree of freedom trajectory computations for Project Caleb.

Carroll, C. J. and Frandsen, N. P.: Static Stability, Control and Drag Measurements of the Arm Missile at Mach Numbers of 0.8, 1.3 and 2.76. (U) NavOrd Report 6779 CONFIDENTIAL

Abstract: This report presents the results of an investigation in the NOL Supersonic Tunnel No. 1 to measure the static stability, control, and drag of a 0.1333 scale force model and a 0.1515 scale hinge moment model of the ARM missile. These data were obtained at Mach numbers of 0.80, 1.30, and 2.76.

Carroll, C. J., Frandsen, N. P. and Knott, J.: Static Stability, Control, and Drag Measurements of the Cobra Missile at Mach Numbers of 0.60, 0.80, 0.90, 1.10, 1.30, 1.76 and 2.76. (U) NavOrd Report 6780 CONFIDENTIAL

Abstract: This report presents the results of an investigation in the NOL Supersonic Tunnel No. 1 to measure the static stability, control, and drag of a 0.1333 scale force model and a 0.1515 scale hinge moment model of the Cobra missile. These data were obtained at Mach numbers of 0.60, 0.80, 0.90, 1.10, 1.30, 1.76, and 2.76.

Carroll, C. J.: Static Stability and Drag of the Hopi Weapon. (U) NavOrd Report 6783. CONFIDENTIAL

Abstract: This report presents the results of an investigation in the NOL Supersonic Tunnel No. 1 to measure the normal force, axial force, and pitching moment of the Hopi weapon. These data were obtained at Mach numbers of 0.76, 0.90, 1.57, 2.17, and 3.25.

Carroll, C. J. and Frandsen, N. P.: Static Stability and Control Test of a 1/10 Scale Model of the Terrier Missile at Mach Numbers of 2.17 and 2.76.(U) NavOrd Report 6868. CONFIDENTIAL

Abstract: This report presents the results of an investigation in the NOL Supersonic Tunnel No. 1 to measure pitch, yaw, and roll data of the Terrier missile. These data were obtained at Mach numbers of 2.17 and 2.76.

Carroll, C. J. and Frandsen, N. P.: Static Stability and Control Test of a 1/10 Scale Model of the Advanced Tartar Missile at Mach Numbers of 2.54 and 3.24.(U) NavOrd Report 6870. CONFIDENTIAL

Abstract: This report presents the results of an investigation in the NOL Supersonic Tunnel No. 1 to measure the static stability and control of an APL research missile configuration. These data were obtained at Mach numbers of 2.76 and 3.51.

Carroll, C. J. and Groves, R. T.: Pitch Damping of a 0.15-to-1 Scale Model of the Sidewinder 1C Missile at Mach Numbers of 1.53, 1.76, 2.28, 2.54, and 3.26.(U) NavOrd Report 6836. CONFIDENTIAL

Abstract: This report presents the results of an investigation in the NOL Supersonic Tunnel No. 1 to measure the pitch damping of the Sidewinder 1C Missile. These data were obtained at Mach numbers of 1.53, 2.76, 2.28, 2.54, and 3.26.

Ceretta, Peter A., DeMeritte, F. J., and Schermerhorn, V. L.: Wind Tunnel Tests of the Mark 28 Bomb and Practice Bomb 104.(U) NavWeps Report 7377. CONFIDENTIAL RESTRICTED DATA

Abstract: CONFIDENTIAL RESTRICTED DATA

Cha, Moon H., and Winkler, Eva M.: Investigation of Flat Plate Hypersonic Turbulent Boundary Layers with Heat Transfer at a Mach Number of 5.2.(U) NavOrd Report 6631. UNCLASSIFIED

Abstract: See Winkler, Eva M. and Cha, Moon H., page 38.

Chones, A. J.: Heat-Transfer and Pressure Measurements on Flat-Faced Flared-Tail Circular Cylinders and Normal Disks.(U) NavOrd Report 6669. UNCLASSIFIED

Abstract: Experimental pressure and temperature distribution data were obtained on both flat-faced, flared-tail circular cylinders and a normal disk at nominal Mach numbers of 2, 5 and 8, over a free-stream Reynolds number range of 7.6×10^5 ft. to 37.0×10^5 ft. The disk measurements permitted an extremely accurate determination of the velocity gradient at the stagnation point. Comparison of the heat-transfer determinations is made with theory, and the agreement is within 10 percent. Shock detachment distance measurements agreed within 20 percent with theoretical predictions.

Chones, A. J. and Hastings, S. M.: Supersonic Aerodynamic Heating of a Yawed Sphere-Cone Wind-Tunnel Model. (U) NavOrd Report 6812. UNCLASSIFIED

Abstract: See Hastings, S. M. and Chones, A. J., page 23.

Conlan, J.: An Existence Theorem for the Equation $u_{xyz} = f$. NavOrd Report 6921. UNCLASSIFIED

Abstract: This paper proves an existence theorem for a boundary value problem for the partial differential equation

$$u_{xyz} = f(x, y, z, u, u_x, u_y, u_z, u_{xz}, u_{yz})$$

The method of proof is such as to lead directly to a simple scheme for the numerical solution of such a problem.

Conlan, J., Diaz, J. B. and Parr, W. E.: On the Capacity of the Icosahedron. NavWeps Report 7302. UNCLASSIFIED

Abstract: The numerical estimation of the capacity is one of the chief examples of the actual application of variational methods. The main purpose of the present report is to obtain upper bounds for the capacity of a regular solid by means of a simple trial function.

Corning, Gerald: The pitch-yaw-roll Coupling Problem of Guided Missiles at High Angles of Pitch. NavWeps Report 7363. UNCLASSIFIED

Abstract: A study has been made of the pitch-yaw-roll coupling problem to determine: (a) how the problem arises, (b) the general effects of this coupling on the flight of missiles, and (c) how the adverse effects of the coupling can be minimized.

Crogan, Leonard E.: Drag Characteristics at Subsonic and Supersonic Velocities and Stability Data at Muzzle Velocity Obtained from Free-Flight Model Firings of a 3-inch Mk 34 Mod 1 High-Capacity Projectile. (C) NavOrd Report 6300. CONFIDENTIAL

Abstract: Drag coefficients at various velocities and stability data at muzzle velocity were obtained for the 3-inch Mk 34 projectile by firing 0.312-scale models in the NOL aerodynamics and pressurized ballistics ranges. Drag coefficients were corrected to zero yaw, and in addition were calculated for the full-scale projectile by considering Reynolds number effect. Both the model and full-scale projectile are gyroscopically and dynamically stable at muzzle velocity.

Crogan, Leonard E.: Drag and Roll Coefficients at Subsonic to Supersonic Velocities of 1/7-Scale Free-Flight Models of the 1,000 Pound Low-Drag Bomb (EX-10). NavOrd Report 6661. UNCLASSIFIED

Abstract: Drag and roll coefficients at various velocities have been obtained for the low-drag bomb (EX-10) by firing 1/7-scale models of the 1,000 pound bomb in the NOL Aerodynamics Range. Drag coefficients for models with and without carrying lugs were corrected to zero yaw. Roll coefficients for models with carrying lugs also were corrected to zero yaw.

Crogan, Leonard E.: Drag and Stability for the Jupiter Warhead Obtained from Free-Flight Model Firings at Hypersonic Velocities ($3.16 < M < 8.54$). (C) NavOrd Report 6798. CONFIDENTIAL

Abstract: Range firings have been conducted using three sizes of Jupiter nose cone models to obtain drag and stability data at Mach numbers from 3.16 to 8.54. The model was found to be both statically and dynamically stable at the Mach numbers investigated.

Crogan, Leonard E.: Drag and Stability Data Obtained from Free-Flight Range Firings within the Mach Number Range of 0.4 to 3.0 for Several Cylindrical Configurations. NavOrd Report 6731. UNCLASSIFIED

Abstract: Tests were conducted in the Aerodynamics Range No. 1 at the Naval Ordnance Laboratory on several cylindrical configurations to determine their drag and stability characteristics. The configurations consisted of four types: three types of fin-cylinders and an offset C.G. cylinder, i.e., one whose C.G. is off the axis of the cylinder. These were fired within the Mach number range of 0.4 to 3.0. Drag and stability coefficients were obtained for the configurations.

Crogan, Leonard E.: Drag and Stability Data for Several Samos Configurations Obtained from Free-Flight Model Firings. (C) NavWeps Report 7389. CONFIDENTIAL

Abstract: Firings of several Samos configurations were conducted in the Naval Ordnance Laboratory Pressurized Ballistics Range No. 3. The configurations differed in nose corner radius only. It was observed that with a decrease in the nose corner radius, the drag coefficient increased, the slope of the normal force coefficient decreased, and the slope of the pitching moment coefficient increased. From these experimental data, it was concluded that a decrease in the nose corner radius resulted in a rearward movement of the center of pressure.

Danberg, James E.: Measurement of the Characteristics of the Compressible Turbulent Boundary Layer with Air Injection. NavOrd Report 6683. Unclassified

Abstract: Turbulent boundary-layer velocity and temperature profiles were measured on a porous flat plate at a Mach number of 5.1 with rates of air injection from zero to 0.8 percent of free-stream mass flow. The Reynolds number was 1.5×10^7 per meter and wall to free-stream temperature ratios were 4.2 and 5. Experimental temperature and velocity profiles and the associated skin-friction coefficients were compared with the theories of Rubesin and Persh.

Darling, J. A.: Recovery Factor and Capture Area Ratio of the 1/20-Scale Triton Integrated Diffuser Model at Mach Number 3.24. (U) NavOrd Report 6199. CONFIDENTIAL

Abstract: This report presents the results of an investigation in the NOL 40x40 cm Supersonic Tunnel No. 2 to measure the recovery factor and the capture area ratio of the 1/20-scale Triton integrated diffuser model. These data were obtained at Mach Number 3.24.

Darling, J. A.: Recovery Factor and Capture-Area Ratio of the 1/20-Scale Triton Integrated Diffuser Model at Mach Numbers 2.87 and 3.24. (U) NavOrd Report 6689. CONFIDENTIAL

Abstract: This report presents the results of an investigation in the NOL Supersonic Tunnel No. 2 to measure the recovery factor and the capture-area ratio of the Triton 1/20-scale integrated diffuser model. These data were obtained at Mach numbers of 2.87 and 3.24.

Darling, J. A.: Static Stability of the ML-404 Polaris Re-Entry Stage at Mach Numbers of 6.77 and 8.20. (U) NavOrd Report 6758. CONFIDENTIAL

Abstract: Various configurations of the Polaris ML-404 re-entry stage were tested in the NOL Hypersonic Tunnel No. 4 in order to obtain static stability information at Mach numbers of 6.77 and 8.20. Measurements with the basic configuration were made through an angle-of-attack range from zero degrees to 180 degrees.

Darling, J. A.: Normal Force and Pitching Moment Coefficients of ML-404 Polaris Re-Entry and Polaris Second Stage Configurations at Mach Numbers 6.74, 8.12, and 10.15. (U) NavOrd Report 6819. CONFIDENTIAL

Abstract: Normal force and pitching moment coefficients were obtained for seven re-entry and three second-stage Polaris configurations in the NOL Hypersonic Tunnel No. 4 through an angle-of-attack range of -6° to $+20^{\circ}$ at Mach numbers 6.74, 8.12, and 10.15.

Darling, J. A.: Normal Forces and Pitching Moments of Jupiter, Pershing, and Redstone Warheads at Mach Numbers 6.77, 8.20, and 10.15. (U) NavOrd Report 6910. CONFIDENTIAL

Abstract: Normal force and pitching-moment coefficients for various Jupiter, Pershing, and Redstone warheads were obtained as a result of wind-tunnel tests at Mach numbers 6.77, 8.20, and 10.15 in the Hypersonic Tunnel No. 4. These tests were made for an angle-of-attack range of -4° to $+10^{\circ}$ and Reynolds number per foot, based on free-stream conditions of 5.7, 3.0, and 1.3×10^{6}.

Darling, J. A.: Normal Force and Pitching Moments of Pershing Missile Second Stage and Re-Entry Configurations at Mach Numbers 6.74, 8.20 and 10.15. (U) NavWeps Report 7270. CONFIDENTIAL

Abstract: Normal-force and pitching-moment coefficients of Pershing missile configurations for two phases of the development program were obtained as the result of wind-tunnel tests at Mach numbers of 6.74, 8.20, and 10.15 in Hypersonic Tunnel No. 4. The data were obtained through an angle-of-attack range of -4° to $+10^{\circ}$ and at Reynolds number per foot of 5.6×10^{6}, 3.0×10^{6}, and 1.3×10^{6} respectively, based on free-stream conditions.

Dawson, V. C. D.: Piston Type Strain Gages. NavOrd Report 6251. UNCLASSIFIED

Abstract: For the past several years piston type strain gages have been used at the Naval Ordnance Laboratory ballistic range facilities to record pressures. The theory used to predict the frequency response, sensitivity and pressure limit of such gages is presented.

Dawson, V.C.D.: Elastic and Plastic Stress Equations for Hollow Cylinders and Spheres Subjected to Internal and External Pressure. NavOrd Report 6786. UNCLASSIFIED

Abstract: The equations used to design high-pressure vessels, both cylindrical and spherical, are given. Where strength requirements are not severe, the elastic equations, together with the distortion energy theory of failure, are used. For chambers having high-pressure requirements, it is necessary to resort to a shrink fit or autofrettage construction. The equations for these processes are derived herein. A short discussion of bursting strength of high-pressure chambers is also included.

Dawson, V.C.D.: Pressure-Gage Design for the Measurement of Pressures in Shocktube Wind Tunnels, Shock Tubes and Guns. (U) NavWeps Report 7326. UNCLASSIFIED

Abstract: This report describes the pressure-gage design and circuitry of the piston-type strain gages which are used by the Naval Ordnance Laboratory for the measurement of pressures in shocktube wind tunnels, shock tubes and guns. The pressures measured with gages of this type cover the range from a few psi to over 100,000 psi.

Dawson, V.C.D.: Measurement of Shock Velocity by Means of a Strain Gage. (U) NOL Technical Report 61-116). UNCLASSIFIED

Abstract: One of the measurements usually made in a shocktube or shocktube wind tunnel is that of shock velocity. Several techniques have been successfully developed in past years. However, all of these methods require a transducer which is inserted through the shocktube wall. A strain-gage system has been developed recently which provides reliable results without the necessity of machining the tube wall. This report deals with this technique and the results obtained.

Dawson, V.C.D., Noonan, B.J., and Waser, R.H.: Experimental Stress Analysis of a Spherical Combustion Chamber. NavWeps Report 7319. UNCLASSIFIED

Abstract: The advantages of spherical combustion chambers with respect to strength and ignition, make their use particularly desirable for shock tunnels and high-speed launchers. The difficulties of design and fabrication have generally limited their widespread application. A spherical type of chamber has been designed and fabricated during the past year. This report describes the experimental stress analysis of the chamber that was made during its acceptance test, together with the subsequent modification of the chamber.

DeGrafft, William E.: Static Stability of a 1/15-Scale Model of the Super Talos Missile,(U) NavOrd Report 6800. CONFIDENTIAL

Abstract: This report presents the results of an investigation in the Naval Ordnance Laboratory Supersonic Tunnel to determine the static stability in terms of force and moment coefficients and to measure the internal static pressure of a ramjet powered Super Talos missile using a 1/15-scale model. Louvers in one wing root were set at various openings allowing portions of the internal flow to escape. These data were obtained at Mach numbers of 3.50 and 4.09.

DeGrafft, William E.: Effects of Booster Separation on the Static Stability of a 0.09375-Scale Model of the Typhon L.R. Missile.(U) NavWeps Report 7305. CONFIDENTIAL

Abstract: This report presents the results of an investigation in the NOL Supersonic Tunnel to determine the effects of booster separation on the static stability of the Typhon L. R. missile using a 0.09375-scale model. These data were obtained at Mach numbers of 3.24 and 3.50.

DeMeritte, F. J.: The Correlation of Range and Wind-Tunnel Dynamic Stability Measurements. NavOrd Report 6765. UNCLASSIFIED

Abstract: The Naval Ordnance Laboratory has been making dynamic stability investigations in supersonic wind tunnels since 1950. These data were derived from measurements of pitch damping, roll damping, and Magnus forces and moments. The techniques used for making these measurements in wind tunnels are described briefly, and the wind-tunnel data are compared with ballistic range results. The comparison of the measurements made in the wind tunnel and firing ranges shows that the data are in good agreement.

DeMeritte, F. J., Ceretta, P. A. and Schermerhorn, V.: Wind-Tunnel Tests of the Mark 28 Bomb and Practice Bomb 104.(U) NavWeps Report 7377. CONFIDENTIAL RESTRICTED DATA

Abstract: CONFIDENTIAL RESTRICTED DATA

DeMeritte, F. J. and Gauzza, H. J.: Correlation of Base Pressure from Wind Tunnels and Free-Flight on the Polaris Re-Entry Body.(U) NavOrd Report 6885. CONFIDENTIAL

Abstract: The Polaris missile is equipped with a barometric fuze mounted at the base of the re-entry body. In order to determine accurately the burst height of the warhead, the base-pressure ratio of the Polaris re-entry body at various Mach numbers and angles of attack must be known. This report presents a comparison of free-flight data obtained from 1/3 and 1/2-scale Polaris re-entry bodies launched at Wallops Island Station, National Aeronautics and Space Administration, with data obtained in the wind tunnels of the Naval Ordnance Laboratory and of the David Taylor Model Basin. The comparisons of the results show that the data from free flight are in good agreement with the results from the wind tunnels.

DeMeritte, F. J. and Piper, W. D.: Summary of the NOL Investigations to Date of the Aerodynamic Characteristics of the Navy Low Drag Bomb.(U) NavOrd Report 5679. CONFIDENTIAL

Abstract: See Piper, W. D. and DeMeritte, F.J., page 30.

DeMeritte, F. J. and Schermerhorn, V.: Pitch Damping Tests of Proposed Polaris Exit and Re-Entry Stage Configurations, (U) NavOrd Report 6846. CONFIDENTIAL

<u>Abstract:</u> See Schermerhorn, V. and DeMeritte, F. J., page 33.

DeMeritte, F. J. and Schermerhorn, V.: Pitch Damping of the Pershing Re-Entry Body.(U) NavOrd Report 6896. CONFIDENTIAL

<u>Abstract:</u> See Schermerhorn, V. and DeMeritte, F. J., page 33.

DeMeritte, F. J. and Schermerhorn, V.: Pitch Damping Tests of the NOTS Experimental Rocket EV II.(U) NavOrd Report 7282. CONFIDENTIAL

<u>Abstract:</u> See Schermerhorn, V. and DeMeritte, F. J., page 33.

DeMeritte, F. J. and Schermerhorn, V.: Wind-Tunnel Tests of the Navy Low-Drag Bomb at Angles of Attack up to 70 Degrees. NavOrd Report 7291. UNCLASSIFIED

<u>Abstract:</u> See Schermerhorn, V. and DeMeritte, F. J., page 34.

DeMeritte, F. J. and Shantz, I.: Summary of the Dynamic Stability Wind-Tunnel Test at NOL in Support of the Polaris Mark I.(U) NavOrd Report 6802. CONFIDENTIAL

<u>Abstract:</u> See Shantz, I. and DeMeritte, F. J., page 35.

DeMeritte, F. J. and Shantz, I.: Limited Wind-Tunnel Tests of the Mk 89 Practice Bomb. NavOrd Report 6852. UNCLASSIFIED

<u>Abstract:</u> This report presents the results of an investigation in the NOL Supersonic Tunnel to determine the pitch stability and drag of the Mk 89 practice Bomb. These data were obtained at Mach numbers of 0.91, 0.83, 0.64 and 0.47.

DeMeritte, F. J. and Shantz. I.: Pitch Damping Tests of Two Proposed Polaris Re-Entry Bodies.(U) NavOrd Report 6855. CONFIDENTIAL

<u>Abstract:</u> See Shantz, I. and DeMeritte, F. J., page 35.

DeMeritte, F. J. and Steinle, W. C.: Total Pressure Recovery of the Talos 6b2 Diffuser at Supersonic Speeds.(U) NavOrd Report 6031. CONFIDENTIAL

<u>Abstract:</u> See Steinle, W. C. and DeMeritte, F. J., page 37.

DeMeritte, F. J. and Steinle, W. C.: Total Pressure Recovery of the Talos 6b2 and 6bWIA diffuser at Supersonic Speeds. (U) NavOrd Report 6833. CONFIDENTIAL

Abstract: See Steinle, W. C. and DeMeritte, F. J., page 36.

Conlan, James, Diaz, J. B. and Parr, W. E.: On the Capacity of the Icosahedron. NavWeps Report 7302. UNCLASSIFIED

Abstract: The numerical estimation of the capacity is one of the chief examples of the actual application of variational methods. The main purpose of the present report is to obtain upper bounds for the capacity of a regular solid by means of a simple trial function.

Crogan, Leonard E.: Drag and Stability Data Obtained from Free-Flight Range Firings Within the Mach Number Range of 0.4 to 3.0 for Several Cylindrical Configurations. NavOrd Report 6731. UNCLASSIFIED

Abstract: Tests were conducted in the Aerodynamics Range No. 1 at the Naval Ordnance Laboratory on several cylindrical configurations to determine their drag and stability characteristics. The configurations consisted of four types: three types of fin-cylinders and an offset C.G. cylinder, i.e., one whose C.G. is off the axis of the cylinder. These were fired within the Mach number range of 0.4 to 3.0. Drag and stability coefficients were obtained for the configurations.

Douglis, Avron: On Discontinuous Solutions of Quasi-Linear, First Order Partial Differential Equations. NavOrd Report 6775. UNCLASSIFIED

Abstract: Economical ways to calculate the action and interaction of shocks in the solution of non-linear hyperbolic differential equations are well tested empirically but have not been completely founded in theory. In this report, theoretical justifications are given of a family of such methods for a simple equation. The methods treated include, among others, that of non-linear viscosity introduced by von Neumann and Richtmyer, a modified method of linear viscosity, and a procedure not based upon viscosity.

Douglis, Avron: On Calculating Solutions of Quasi-Linear, First Order Partial Differential Equations. NavWeps Report 7254. UNCLASSIFIED

Abstract: A common means to calculate solutions of non-linear hyperbolic partial differential equations, when shocks are present, is to introduce into an otherwise straightforward difference scheme special terms which might represent the action of a fictitious tempering mechanism, perhaps of some dissipative type. Experience seems to justify the use of such "tempered" schemes, but proofs of convergence are largely incomplete or lacking. In this report, in the case of a simple type of equation, we shall give convergence proofs for a class of explicit tempering schemes including versions of the von Neumann-Richtmyer, and the Lax-Wendroff methods. These results supplement those of a previous report devoted to tempering schemes of implicit type (and to an explicit scheme with linear viscosity).

Eckerman, Jerome: The Measurement of the Rate of Dissociation of Oxygen at High Temperatures. NavOrd Report 6724. UNCLASSIFIED

Abstract: A new technique is described with which reaction rates in gases can be determined at high temperatures. A mechanism of the shock location in front of a sphere traveling at supersonic speeds is proposed. Then, the relation between the shock separation distance and the rate of dissociation is discussed. The method is applied to the dissociation of diatomic oxygen. The separation distance of the shock wave from the sphere is measured on photographs of the sphere in flight. The dissociation rate is given which provides the best fit of predicted detachment distance to the experimentally observed distance.

Enkenhus, Kurt R.: The Flight Environment of Long-Range Ballistic Missiles and Glide Vehicles. NavOrd Report 6745. UNCLASSIFIED

Abstract: The flow conditions encountered in the flight of long-range ballistic missiles and glide vehicles are reviewed. Flow parameters were calculated using the flight trajectory equations of Eggers, Allen, and Niece with a simplified atmospheric model. Graphs are given indicating the relationships of aerodynamic drag and heating, real-gas effects, and rarefied-gas phenomena to vehicle trajectories. The vehicle trajectories, in turn, are approximately determined by a few fundamental parameters such as the range, vehicle weight, drag coefficient, and, in the case of glide vehicles, the lift/drag ratio.

It is concluded that rarefied-gas effects are dominant in the decay of satellite orbits but are of little importance in most surface-to-

surface missions. The most severe environmental conditions are encountered in hypersonic continuum flow.

Fisher, Paul D. and Lankford, John L.: Investigation of Interstage Pressures and Forces on a 4-Percent Titan SM-68B Model Through a Range of Simulated Altitudes. (U) NavWeps Report 6923. CONFIDENTIAL

Abstract: An investigation has been conducted on a 4-percent scale Titan SM-68B model in an altitude chamber. Pressures and forces have been measured. Cold flow simulation of sustainer engine rocket flow was simulated at various rocket chamber pressures and at simulated altitudes from 30,000 to 100,000 feet. Several interstage configurations were investigated through a range of interstage parameters.

Fontenot, John E., Jr.: Free-Flight Model Tests for Drag and Stability of Three Cone-Cylinder Flare-Configurations. (U) NavOrd Report 6805. CONFIDENTIAL

Abstract: Three ICBM shapes were fired in the Pressurized Ballistics Range No. 3 to determine drag, stability, and pressure distribution in a Mach number range of 4.0 to 8.0. It was found that the bluntest shape with the longest flare was the most stable shape, both dynamically and statically. Possible real gas effects were also noted in the drag coefficient of the bluntest shape above Mach number 7. This report also discusses the launching difficulties incurred in the Mach number 8 firings.

Frandsen, N. P. and Carroll, C. J.: Static Stability, Control and Drag Measurements of the Arm Missile at Mach Numbers of 0.8, 1.3, and 2.76. (U) NavOrd Report 6779. CONFIDENTIAL

Abstract: This report presents the results of an investigation in the NOL Supersonic Tunnel No. 1 to measure the static stability, control, and drag of a 0.1333 scale force model and a 0.1515 scale hinge moment model of the Arm missile. These data were obtained at Mach numbers of 0.80, 1.30, and 2.76.

Frandsen, N. P., Carroll, C. J. and Knott, J.: Static Stability, Control, and Drag Measurements of the Cobra Missile at Mach Numbers of 0.60, 0.80, 0.90, 1.10, 1.30, 1.76 and 2.76. (U) NavOrd Report 6780. CONFIDENTIAL

Abstract: See Carroll, C.J., Frandsen, N.P. and Knott, J., page 1.

Frandsen, N. P. and Carroll, C. J.: Static Stability and Control Test of a 1/10 Scale Model of the Terrier Missile at Mach Numbers of 2.17 and 2.76.(U) NavOrd Report 6868. CONFIDENTIAL

Abstract: See Carroll, C. J. and Frandsen, N.P., page 2.

Frandsen, N. P. and Carroll, C. J.: Static Stability and Control Test of a 1/10 Scale Model of the Advanced Tartar Missile at Mach Numbers of 2.54 and 3.24.(U) CONFIDENTIAL

Abstract: This report presents the results of an investigation in the NOL Supersonic Tunnel No. 1 to determine static stability and control characteristics of the Advanced Tartar missile. These data were obtained at Mach numbers of 2.54 and 3.24.

Frandsen, N. P. and Carroll, C. J.: Static Stability and Control Test of an APL Research Missile Configuration at Mach Numbers of 2.76 and 3.51.(U) NavOrd Report 6870. CONFIDENTIAL

Abstract: See Carroll, C. J. and Frandsen, N.P., page 2.

Galloway, Howard L. Jr.: Effect of Jet on Base Pressure Distribution.(U) NavOrd Report 6310. CONFIDENTIAL

Abstract: Pressure distribution measurements at the base and the aft portion of the cylindrical body of an 0.0190-scale Jupiter model have been conducted in the NOL Supersonic Tunnel No. 2. The model was equipped with a side support through which high pressure air was supplied. The air was exhausted from the model through a simulated nozzle. These tests were carried out to determine the effect of the jet on the base pressure and the pressure distribution over the aft portion of the body at Mach numbers from 0.26 to 2.50 and in a Reynolds number range from 1.20×10^6 to 1.77×10^6.

Galloway, Howard L.: Pressure Distribution over Models of Dome and Arch Structures. NavOrd Report 6699. UNCLASSIFIED

Abstract: This report presents the results of an investigation in the NOL Supersonic Tunnel No. 2 to measure the static pressure distribution over dome shaped buildings and arch shaped buildings at Mach numbers from 0.401 to 1.75. These data were obtained to provide information on instantaneous airloads acting on protective structures exposed to air blasts.

Gates, John D.: Static Stability and Control Test of a 1/10-Scale Model of the Advanced Terrier Missile at Mach Number 4.10.(U) NavOrd Report 6218. CONFIDENTIAL

Abstract: This report presents the results of an investigation in the NOL Supersonic Tunnel No. 2 to measure the normal and yaw forces as well as the pitching, yawing, and rolling moments of the Advanced Terrier missile configuration with different control surface settings. These data were obtained at Mach number 4.10.

Gates, John D.: Static Stability and Control Test of a 1/10-Scale Model of Advanced Terrier Missile at Mach Numbers of 3.24 and 4.81.(U) NavOrd Report 6220. CONFIDENTIAL

Abstract: This report presents the results of an investigation in the NOL Supersonic Tunnels No. 1 and No. 2 to measure the pitch, yaw, and roll moments and normal side forces of the Advanced Terrier configuration.

Gates, John D.: Static Stability and Control Test of a 1/10-Scale Model of the Advanced Terrier Missile at Mach Numbers of 2.18, 2.76 and 3.25.(U) NavOrd Report 6309. CONFIDENTIAL

Abstract: This report presents the results of an investigation in the NOL Supersonic Tunnel No. 1 to obtain the pitching, yawing, and rolling moments and normal and side forces of the Advanced Terrier Missile. These data were obtained at Mach numbers of 2.18, 2.76 and 3.25.

Gates, John D.: Static Stability Control Test of a 1/11-Scale Model of the Advanced Tartar Missile at Mach Number 4.10.(U) NavOrd Report 6311. CONFIDENTIAL

Abstract: This report presents the results of an investigation in the NOL Supersonic Tunnel No. 2, to measure the pitching, yawing, and rolling moments of the Advanced Tartar missile configurations. These data were obtained at a Mach number of 4.10.

Gates, John D.: Static Stability and Control Test of a 1/11-Scale Model of the Advanced Tartar Missile with the B_5 Body at Mach Number 4.10.(U) NavOrd Report 6635. CONFIDENTIAL

Abstract: This report presents the results of an investigation in the NOL Supersonic Tunnel No. 2 to measure the pitching, yawing, and rolling moments of the Advanced Tartar missile configurations.

Gates, John D.: Stability and Control of the SSGM at Mach Numbers 2.48, 2.76, 3.24, 4.10, and 4.810.(U) NavOrd Report 6678 CONFIDENTIAL

Abstract: This report presents the results of an investigation in the NOL Supersonic Tunnel No. 1 to measure the pitch, yaw, and roll moments and normal and side forces of the SSGM configuration. These data were obtained at Mach numbers 2.48, 2.76, 3.24, 4.10, and 4.81.

Gates. John D.: Longitudinal and Lateral Stability and Control Test of a 1/10-Scale Model of the Terrier Missile at Mach Numbers of 2.76 and 3.51.(U) NavOrd No. 6764. CONFIDENTIAL

Abstract: This report presents the results of an investigation in the NOL Supersonic Tunnel No. 1 to obtain the pitching, yawing, and rolling moments and normal and side forces of the Terrier Missile. These data were obtained at Mach numbers of 2.76 and 3.51.

Gates, John D.: Base-Pressure Test of the Polaris (N_{6A} -B_3S_{16A}) Re-Entry Stage at Mach Numbers 0.60, 0.65, 0.70, 0.74, 0.80 and 0.90, CONFIDENTIAL NavOrd Report 6862.

Abstract: A base-pressure test of the Polaris re-entry stage was conducted in the NOL Supersonic Tunnel No. 1. Data were obtained at Mach numbers 0.60, 0.65, 0.70, 0.74, 0.80, and 0.90.

Gates, John D.: Longitudinal and Lateral Stability and Control Test of a 1/10-Scale Model of the Terrier Missile at Mach Numbers of 2.53 and 4.12.(U) NavOrd Report 6881. CONFIDENTIAL

Abstract: This report presents the results of an investigation in the NOL Supersonic Tunnel No. 1 to obtain the pitching, yawing, and rolling moments and normal and side forces of the Terrier missile. These data were obtained at Mach numbers of 2.53 and 4.12.

Gates, John D.: Longitudinal and Lateral Stability and Control Test of a 1/10-Scale Model of the Terrier Missile at Mach Numbers of 1.76, 2.50, 2.76, and 3.50.(U) NavWeps Report 7295. CONFIDENTIAL

Abstract: This report presents the results of an investigation in the NOL Supersonic Tunnel No. 1 to obtain the pitching, yawing, and rolling moments and normal and side forces of the Terrier missile. These data were obtained at Mach numbers of 1.76, 2.50, 2.76, and 3.50.

Gates, John D.: Longitudinal and Lateral Stability and Control Test of a 1/10 Scale Model of the Terrier Missile at Mach Numbers of 2.03 and 2.76.(U) NavWeps Report 7296. CONFIDENTIAL

Abstract: This report presents the results of an investigation in the NOL Supersonic Wind Tunnel No. 1 to obtain the pitching, yawing, and rolling moments and normal and side forces of the Terrier missile. These data were obtained at Mach numbers of 2.03 and 2.76.

Gates, John D.: Longitudinal and Lateral Stability and Control Test of a 1/10 Scale Model of the Terrier Missile at Mach Numbers of 2.03, 2.53, 3.05, and 4.12.(U) CONFIDENTIAL NavWeps Report 7297

Abstract: This report presents the results of an investigation in the NOL Supersonic Tunnel No. 1 to obtain the pitching, yawing, and rolling moments and normal and side forces of the Terrier missile. These data were obtained at Mach numbers of 2.03, 2.53, 3.05, and 4.12.

Gates, John D. Static Stability and Drag Test of the Mark-57 Mine at Mach Numbers 0.43 to 0.90.(U) NavWeps Report 7298. CONFIDENTIAL

Abstract: This report presents the results of an investigation in the NOL Supersonic Tunnel No. 1 to obtain the pitching moments and normal and axial forces of the Mark-57 mine. These data were obtained at Mach numbers 0.43 and 0.90.

Gates, D. F. and Bixler, D. N.: "The Measurement of Aerodynamic Forces and Moments in the NOL 4-in. Hypersonic Shock Tunnel No. 3.(U) NOLTR 61-100. Unclassified

Abstract: Light-weight models of missiles are suspended by fine threads in the shock tunnel test section. These models, along with a similarly suspended sphere, break free from their supporting threads and experience free flight at flow initiation. Motion of the models and sphere is recorded photographically with a high-speed framing camera and coordinates are read from the resulting film strips. Methods of analysis are discussed for determining aerodynamic force and moment coefficients from resulting data.

Gates, D. F. and Watt, J. W.: Stagnation Point Heat Transfer to a Sphere in the NOL 6-in. Shocktube. NavOrd Report 6788. Unclassified

Abstract: Heat-transfer measurements with a calorimeter type heat-transfer gage were taken in the NOL 6-in. Shocktube on 3/4-in. and 1-in. diameter spheres. Shock strengths of Mach number 3 to 5 into 30 millimeters (Hg) of air produced high temperature flows of approximately one-half millisecond duration. The experimental stagnation point heat-transfer values were determined and compared with the values predicted by the theory of Fay and Riddell.

Gauzza, H. J.: Base Pressure Measurements of the Polaris Re-Entry Body. (U) NavOrd Report 6212. CONFIDENTIAL

Abstract: Base pressure tests of the Polaris re-entry body have been conducted in the NOL 40x40 Aeroballistics Tunnel No. 2 and the David Taylor Model Basin 18x18-inch Supersonic Tunnel at subsonic and transonic speeds. Base pressures were measured using 0.115 scale wind-tunnel models containing individual as well as manifolded pressure taps to determine the effects of angle of attack and high surface temperature.

Gauzza, H. J.: Aerodynamic Characteristics of Several Little Lulu Configurations. (U) NavOrd Report 6781. SECRET

Abstract: SECRET

Gauzza, H. J.: Aerodynamic Characteristics of the EX-38 Chemical Bomb. (U) NavOrd Report 7255. CONFIDENTIAL

Abstract: Results are presented in this report of an aerodynamic investigation of several fin configurations for the EX-38 chemical bomb in the NOL Supersonic Tunnel No. 1 at a Mach number of 0.80. Six-component static force and moment data, as well as pitch damping data, were obtained using 0.125 and 0.0714-scale static and dynamic models respectively. Static stability at roll angles of zero, 22.5, and 45 degrees and dynamic stability at 45 degrees were investigated. Static and dynamic stability were presented in all the cases tested.

Gauzza, H. J. and DeMeritte, F. J.: Correlation of Base Pressure from Wind-Tunnels and Free Flight on the Polaris Re-Entry Body. (U) NavOrd Report 6885. CONFIDENTIAL

Abstract: See DeMeritte, F. J. and Gauzza, H. J., page 9.

Gauzza, H. J. and Wachsler, E.: Pressure Tests of Several Diffuser-Wing-Body Combinations of a 0.0933 Scale SSGM. (U) NavOrd Report 6179. CONFIDENTIAL

Abstract: See Wachsler, E. and Gauzza, H. J., page 37.

Gleyzal, Andre: The Rotation Vector in Computing Trajectories. NOLTR 61-48. Unclassified

Abstract: This report considers a set of variables and equations relating angular velocity and orientation of a rigid body. Three independent variables define an orientation of these variables and time derivatives are related to transformation tensor and angular velocities by means of functions which are rational functions free of singularities except for square root function. These variables and equations may be convenient for computation of trajectories. Formulation is closely related to formulation based on unimodular quaternion. There is used four variables subject to unimodular constraint instead of three independent variables as in this report.

Glick, Irving: On an Analogue of the Euler-Cauchy Polygon Method for the Partial Differential Equation $u_{x_1 \cdots x_n} = f$. (U) NOLTR 61-26. Unclassified

Abstract: This paper gives constructive proofs of existence theorems for two cases of the partial differential equation $u_{x_1 \cdots x_n} = f$ where f is a function of $x_1, \ldots, x_n$, u and the pure mixed partial derivatives of u up through order $n-1$. The method used is an analogue of the Euler-Cauchy polygon method and yields a numerically feasible procedure for constructing solutions. Two inequalities of independent interest are proved as lemmata for the existence proofs, and the properties of an interesting class of interpolaratory functions are obtained.

Greene, John E.: An Investigation of the Rolling Motion of Cruciform-Fin Configurations. (U) NavOrd Report 6262. Unclassified

Abstract: An experimental investigation of the rolling motion of a cruciform fin-alone and body-fin configuration at angles of attack through 90 degrees has been made by NOL. It has been found that large variations in the steadystate rolling velocity occur with change in angle of attack. The mechanism causing these variations is discussed, using results obtained from roll velocity measurements and smoke picture techniques.

Groves, Robert T. and Carroll, C. J.: Pitch Damping of a 0.15-to-1 Scale Model of the Sidewinder 1C Missile at Mach Numbers of 1.53, 1.76, 2.28, 2.54 and 3.26.(U) NavOrd Report 6836. CONFIDENTIAL

Abstract: See Carroll, C. J. and Groves, Robert T., page 2.

Groves, Robert T. and Shantz, Irving: Dynamic and Static Stability Measurements of the Basic Finner at Supersonic Speeds. NavOrd Report 4516. Unclassified

Abstract: Dynamic stability data in the form of damping force and moment coefficients were obtained in the NOL Supersonic Tunnel No. 1. These measurements were made in the Mach number range 1.58 through 3.24. Static stability data in the form of normal force and pitching moment coefficients were determined in the Mach number range 1.58 through 3.86. Both dynamic and static stability coefficients are compared with free-flight results obtained in the NOL and BRL ballistics ranges.

Hall, R. T.: Generalized Missile Study: Static Stability and Control Wind-Tunnel Data of the GMS Models at Mach Numbers of 1.88 and 3.24.(U) NavOrd Report 4431. CONFIDENTIAL

Abstract: Static stability and control wind-tunnel tests of the GMS models are discussed, and data are presented in tabulated form. The data were obtained using an internally mounted, strain-gage type of balance. The configurations tested were obtained by variations of wings, tails, and tail panel incidence angle. The data were taken at Mach numbers of 1.88 and 3.23 using the NOL 40x40 cm Aeroballistics Tunnel No. 1.

Hall, R. T.: Generalized Missile Study: Tail-Hinge Moment and Force Data for the GMS Models at a Mach number of 3.24.(U) NavOrd Report 4432. CONFIDENTIAL

Abstract: Tail hinge-moment and force data for the GMS models are contained, principally in tabulated form, in this report. The data were obtained on special, internally mounted strain-gage type balances. The configurations tested made use of five different sets of wing planforms and tail panels incidence angles. The data were taken at a Mach number of 3.24 using the NOL 40x40 cm Aeroballistics Tunnel.

Hall, R. T.: The Lift and Drag on a Rotating Cylinder in Supersonic Crossflow. NavOrd Report 6039. UNCLASSIFIED

Abstract: Experimental results are presented in the lift (magnus force) and drag on a rotating cylinder in supersonic crossflow. The data were obtained using smooth and roughened, two-dimensional 3-inch diameter cylinders. The rotating cylinder was tested at Mach numbers 1.75, 2.15, 2.48, and 3.24 over a Reynolds number range from 0.55×10^6 to 1.06×10^6. Rotational speeds of the model were continuously varied from 0 - 400 cps. The NOL Supersonic Tunnel No. 1 was used for this investigation. A discussion of the data is presented in which variations within the three parameters (Mach number, rotational speed, and Reynolds number) are shown, along with magnitudes of the lift and drag. A further review of the data presents possible correlations with similar subsonic data.

Hall, R. T.: Static Stability and Control of the Advanced Terrier Missile at Mach Numbers of 2.48, 3.23, and 3.85.(U) NavOrd Report 7274. CONFIDENTIAL

Abstract: This report presents the results of an investigation made to measure the static stability and control of an Advanced Terrier missile. These data are presented in tabular form. The test was made using the NOL Supersonic Tunnel No. 1, at Mach numbers of 2.48, 3.23, and 3.85.

Hall, R. T.: The Aerodynamic Stability of the Advanced Terrier at Mach Numbers of 2.48, 2.87, 3.24, and 4.10 for Varying Sideslip Angles. NavWeps Report 7278. CONFIDENTIAL

Abstract: This report presents the results of a wind-tunnel investigation made to measure the aerodynamic stability of several configurations of the Advanced Terrier missile under the conditions of varying sideslip angle. The tests were made using the NOL

Supersonic Tunnel No. 1, at Mach numbers of 2.48, 2.87, 3.24 and 4.10.

Hall, R. T.: Wind-Tunnel Tests of the Advanced Terrier for Varying Sideslip Angles at a Mach Number of 3.24.(U) NavWeps Report 7276. CONFIDENTIAL

Abstract: This report presents the results of a wind-tunnel investigation made to measure the aerodynamic stability of several configurations of the Advanced Terrier missile under the conditions of varying sideslip angle. The tests were made using the NOL Supersonic Tunnel No. 1 at a Mach number of 3.24.

Hall, R. T.: The Aerodynamic Loading on Proposed Housings of the Advanced Terrier at a Mach Number of 3.24.(U) NavWeps Report 7277. CONFIDENTIAL

Abstract: This report contains the results of a wind-tunnel test to determine the aerodynamic loading on proposed housings of the Advanced Terrier. The results are presented in tabular form. The test was run using the NOL Supersonic Tunnel No. 1 at a Mach number of 3.24.

Hall, R. T.: Aerodynamic Tail-Hinge Moments of the Advanced Terrier at a Mach Number of 3.24.(U) NavWeps Report 7278. CONFIDENTIAL

Abstract: This report contains the results of a wind-tunnel investigation which was made in order to determine the aerodynamic tail-hinge moments for the Advanced Terrier. These data are presented in tabular form. The test was made using the NOL Supersonic Tunnel No. 1 at a Mach number of 3.24.

Hall, R. T.: The Aerodynamic Stability of the Advanced Terrier for Varying Sideslip Angles at a Mach Number of 3.24.(U) NavWeps Report 7279. CONFIDENTIAL

Abstract: This report presents the results of a wind-tunnel investigation made to measure the aerodynamic stability of several configurations of the Advanced Terrier under the conditions of varying sideslip angle. The tests were made using the NOL Supersonic Tunnel No. 1 at a Mach number of 3.24.

Hall, R. T.: Wind-Tunnel Tests of the Advanced Terrier at a Mach Number of 3.24 for Varying Sideslip Angles. (U) NavWeps 7282 CONFIDENTIAL

Abstract: This report presents the results of a wind-tunnel investigation made to measure the aerodynamic stability of several configurations of the Advanced Terrier under the conditions of varying sideslip angles. The tests were made using the Naval Ordnance Laboratory Supersonic Tunnel No. 1 at a Mach number of 3.24.

Hastings, S. M. and Chones, A. J.: Supersonic Aerodynamic Heating of a Yawed Sphere-Cone Wind-Tunnel Model. NavOrd Report 6812. UNCLASSIFIED

Abstract: The steady-state pressure and heat-transfer distributions on a sphere-cone configuration with laminar boundary layer have been determined in a wind tunnel at yaw angles 0° and 6°, and at nominal Mach numbers 3 and 5. Comparison of the 0° yaw local heat-transfer rates with those of the windward body streamline at 6° yaw show a maximum increase for corresponding body stations of approximately 100 percent. The 0° yaw heat-transfer results show good agreement with the recent theory of Powers and Krahn.

Hill, L. L. and Marshall, T.: Propagation of Plane Electromagnetic Waves Through Lossy Dielectric Media. NavWeps Report 7311. UNCLASSIFIED

Abstract: Starting with the electromagnetic field equations, the necessary formulae for describing the propagation of plane electromagnetic waves through a series of dielectric slabs are derived. The results take the form of amplitude reflection and transmission coefficients as functions of the complex conductivity of the dielectrics. The special case of an unknown medium contained between low-loss windows designed as half-wave plates is considered and the simplified equations are presented.

Hubbard, Bert: Bounds for Eigenvalues of the Free and Fixed Membrane by Finite Difference Methods. NavOrd Report 6874. UNCLASSIFIED

Abstract: This paper gives explicit upper and lower bounds for the eigenvalues of both the free and fixed membrane problems in

terms of the eigenvalues of analogous finite difference problems. In each case the difference between the upper and lower bounds is of the order of the mesh width.

Kendall, James M.: Portable Automatic Data Recording Equipment, (PADRE). NavOrd Report 4207. UNCLASSIFIED

Abstract: The PADRE provides a means of automatically punching IBM cards to record data on pressures, forces and moments, temperatures, small temperature differences, mean square values of turbulence, positions of probes during boundary-layer surveys, angles of attack of models in wind tunnels, and any other quantity represented by a voltage, either A.C. or D.C. Seven channels with servo-systems and digital converters of four decimal digits each are provided, besides a means of automatically punching a serial number into each card or punching the clock time. Because of its portability and versatility, PADRE is particularly useful for research work that requires special set-ups.

Kendall, James M.: Method of Measuring the Thermal Diffusivity and Specific Heat of an Ablating Body. NavOrd Report 5771. UNCLASSIFIED

Abstract: A method is presented for measuring as a function of temperature, the heat capacity $\rho c(T)$ and the thermal diffusivity $\kappa(T)$ of a material. From these quantities, the thermal conductivity $K(T)$ is easily obtained. The method, which makes use of an oxyacetylene torch to produce steady-state one-dimensional ablation in the material under test, is capable of giving data up to the failing temperature of the thermocouples (e.g., for chromel-alumel, up to about 1500°C).

Kilmer, E. Eugene and Montgomery, Rayner A.: The Development of an Explosive High-Pressure Release. NavWeps Report 7327. UNCLASSIFIED

Abstract: See Montgomery, Rayner A. and Kilmer, E. Eugene, page

Korobkin, Irving: The Effects of Electronic Exchange on the Efficiency of Vibrational Excitation by Molecular Collisions. NavWeps Report 7268, UNCLASSIFIED

Abstract: A theoretical study has been made of the mechanism for the transfer of molecule translation energy into the internal energy of vibration by molecular collisions. In particular, the research considered the interaction between molecules which can combine chemically to form a covalent bond. The high efficiencies for vibrational excitation previously observed experimentally were explained as being due to electronic exchange effects between the colliding molecules.

Korobkin, Irving: The Effects of the Molecular Properties of an Injected Gas on Compressible Air Laminar Boundary Layer Skin Friction and Heat Transfer. NavWeps Report 7410. UNCLASSIFIED

Abstract: A theoretical study has been made on the effects of the molecular properties of a gas injected into the compressible air laminar boundary layer on a flat plate. A simple rigid sphere model was used for describing transport properties of twenty-seven hypothetical gases, requiring knowledge only of molecular weight and diameter. The specific heat was computed from the equipartition of energy. The research demonstrated that small molecular weight and large molecular diameter reduced skin friction and heat transfer most effectively. Furthermore, large mass specific heat reduced heat transfer but had little effect on skin friction.

Knott, Joseph: Static Stability and Control Test of the Talos 6cl Missile at Mach Numbers of 2.03, 2.27, 2.54, and 2.76.(U) NavOrd Report 6778. CONFIDENTIAL

Abstract: This report presents the results of an investigation in the NOL Supersonic Tunnel No. 1 to measure the normal and side forces, and the pitching, yawing, and rolling moments of the Talos 6cl missile configuratinns with control surface variations. These data were obtained at Mach numbers of 2.03, 2.27, 2.54, and 2.76.

Knott, Joseph, Carroll, C. J. and Frandsen, N. P.: Static Stability, Control and Drag Measurements of the Cobra Missile at Mach Numbers of 0.60, 0.80, 0.90, 1.10, 1.30, 1.76 and 2.76.(U) NavOrd Report 6780. CONFIDENTIAL

Abstract: See Carroll, C. J., Frandesn, N. P. and Knott, J. page 1.

Krahn, Edgar and Powers, John O.: Heat Transfer in Dissociated Air by a Two-Thickness Integral Method. NavOrd Report 6673. UNCLASSIFIED

Abstract: See Powers, John O. and Krahn, Edgar, page 30.

Lankford, J. L.: Preliminary Results of Flow Surveys about an Inclined Body of Revolution at Mach Number 3.5 (Phase I of Aft-Entry Program). NavOrd Report 6707. UNCLASSIFIED

Abstract: An experimental study of the flow field about an ogive-nosed body of revolution has been made at the Naval Ordnance Laboratory; White Oak, Silver Spring, Md. The results have been evaluated with consideration of the effects of the flow field on multiple, aft-inlet installations. Preliminary results are presented for angles of attack up to 15 degrees at a station 7.5 body diameters aft of the nose. Surveys were made with a combination Pitot-conical probe developed for previous flow field studies.

Strong upwash at the sides of the body and strong vortex regions above the body will probably present serious threats to propulsion system performance.

Lankford, J. L.: Pressure Tests of Three Inlet-Diffuser Models for a Low-Volume Ramjet Propulsion System (Phase II; Aft-Entry Program.) (U) CONFIDENTIAL NavOrd Report 6709

Abstract: Wind-tunnel pressure tests have been conducted of three models of a single, full-scale aft-entry inlet diffuser for a low-volume ramjet. The tests were run in two series. The first series was run of three basic models. The second test series was run of modified versions of two of the basic models. These tests were run in the NOL Supersonic Tunnel No. 2 at Mach numbers of 2.75, 3.24 and 3.50.

The results were used to develop a satisfactory configuration and to determine the effectiveness of boundary-layer and auxiliary-air bleed through a perforated ramp and diffuser floor. Schlieren photographs were taken during the experiments to provide qualitative information on flow characteristics outside of the cowl. One of the modified configurations appeared satisfactory for integration into the four-inlet low-volume propulsion system.

Lankford, J. L.: Investigation of the Flow over an Axisymmetric Compression Surface at High Mach Numbers. NavOrd Report 6866.

Abstract: Axisymmetric compression surfaces designed for Mach number 7 have been fired as projectiles in the NOL Pressurized Ballistics Range. Range pressures varied from approximately 100 to 300 millimeters of mercury with a few firings at 1 atmosphere. Range temperature was the ambient or room temperature. Mach numbers from 4.5 to 7.4 were recorded. Results are presented in the form of spark photographs from which data on flow fields and boundary-layer conditions were obtained. The data are analyzed and compared with theory. Although the wall temperatures are too low for simulation of a flight case and the boundary layer appears laminar, the results are of general interest because they represent conditions with a thin boundary layer on a cold surface. A strong effect of wall temperature on separation is noted.

Lankford, J. L.: The Effect of Heat Transfer on the Separation of Laminar Flow over Axisymmetric Compression Surfaces - Preliminary results at Mach Number 6.78. NavWeps Report 7402. UNCLASSIFIED

Abstract: The strong effect of heat transfer on the laminar separation phenomena on hypersonic compression surfaces has been clearly demonstrated using a simple transient model technique. The work was done at NOL(WO) during February 1961. These preliminary hypersonic tunnel results confirm previous theoretical and experimental work done at this laboratory and demonstrate the feasibility of the experimental technique employed.

Lankford, J. L. and Fisher, Paul D.: Investigation of Interstage Pressures and Forces on a 4-percent Titan SM-68B Model through a Range of Simulated Altitudes.(U) NavWeps Report 6923. CONFIDENTIAL

Abstract: An investigation has been conducted on a 4-percent scale Titan SM-68B model in an altitude chamber. Pressures and forces have been measured, Cold flow simulation of sustainer engine rocket flow was simulated at various rocket chamber pressures and at simulated altitudes from 30,000 to 100,000 feet. Several interstage configurations were investigated through a range of interstage parameters.

Lehnert, R. and Schermerhorn, V. L.: Wake Investigation on Sharp and Blunt Nose Cones at Supersonic Speeds. NavOrd Report 5668. UNCLASSIFIED

Abstract: The relationship between local flow conditions at the downstream end of sharp nose and spherical nose, 10° semi-apex angle cones and the corresponding base pressure and wake flow configuration was studied at supersonic speeds. Base pressure and wake angle were found to be the same for both the sharp and the blunt nose cone when the local Mach number and momentum thickness Reynolds number at the end of the cone surface was the same.

Levine, David: Acceleration-Compensating Pressure Transducers for Surface-Pressure Measurements. NavOrd Report 6834. UNCLASSIFIED

Abstract: An acceleration-compensating pressure transducer has been developed to determine flow parameters in the high-performance shock tunnels at the Naval Ordnance Laboratory. The transducer consists of a pressure sensing element, and an acceleration-compensating element. Tests in the NOL shocktube, and in the shocktube wind tunnels have shown that the transducer gives accurate pressure information for the aerodynamic conditions generated in these facilities.

Liccini, L. L. and Redman, E. J.: Normal Forces and Pitching Moments Obtained with a Water-Cooled Internal Strain-Gage Balance at Mach Numbers 5 to 8, using the EX 8-0 (20-mm Projectile) Configuration. (U) NavOrd Report 6303. CONFIDENTIAL

Abstract: See Redman, E. J. and Liccini, L. L., page 33.

Lundquist, G. A.: A Pressure-Telemetering System for Gun-Launched Models. NavOrd Report 6730. UNCLASSIFIED

Abstract: A pressure-telemetering system has been developed for measuring and telemetering base pressures on models launched at transonic speeds in a ballistic range. A simple and rugged transistorized FM-FM telemetering transmitter was contained in a small, cylindrical model. Details of construction and circuitry are given and typical results are presented.

Marshall, T. and Hill, L. L.: Propagation of Plane Electromagnetic Waves through Lossy Dielectric Media. NavWeps Report 7311. UNCLASSIFIED

Abstract: See Hill, L. L. and Marshall, T., page 23.

Montgomery, Rayner A. and Kilmer, E. Eugene: The Development of an Explosive High-Pressure Release. NavWeps Report 7327. UNCLASSIFIED

Abstract: An experimental investigation was conducted to determine the feasibility of using explosives as a diaphragm for sudden release of high-pressure gas. The use of "sheet explosive" will satisfy the conditions of extremely fast action, absence of solid fragments, and a complete opening allowing unrestricted gas flow. Although the contemplated use is that of a muzzle diaphragm to release the working gas in a hypersonic shock tunnel, this type of pressure release may be adaptable to other applications.

Noonan, B. J., Dawson, V.C.D. and Waser, R. H.: Experimental Stress Analysis of a Spherical Combustion Chamber. NavWeps Report 7319. UNCLASSIFIED

Abstract: See Dawson, V.C.D., Noonan, B. J. and Waser, R.H., page 8.

Parr, W. E., Conlan, James and Diaz, J. B.: On the Capacity of the Icosahedron. NavWeps Report 7302. UNCLASSIFIED

Abstract: See Conlan, James, Diaz, J. B. and Parr, W. E., page 3.

Parr, W. E.: Upper and Lower Bounds for the Capacitance of the Regular Solids. NavWeps Report 6318. UNCLASSIFIED

Abstract: Upper and lower bounds are given for the Dirichlet integral, principally based upon an extension of a method of G. Polya and G. Szego. Numerical bounds are calculated for the capacitance of the five regular solids. In particular, it is found that the number 1.3351 is an upper bound for the capacitance of a cube of size 2.0, an improvement over all upper bounds previously known.

Pasiuk, Lionel: Wall Temperature Measurements on an Oscillating Polaris Re-Entry Body at M=6.8.(U) NavOrd Report 6695. CONFIDENTIAL

Abstract: The local wall temperature variations with time on a Polaris Re-Entry Body (Model D) oscillating in a plane, have been determined at a nominal Mach number of 6.8, and free-stream Reynolds number of 3.7×10^6 per foot. Variations of the local wall temperature with time were obtained for oscillations of 5, 10 and 15 cycles per second and angular amplitudes of 5.13°, 10.03° and 14.62°. These data are presented in tabular form and show that the model cylinder and flare temperatures are more influenced by the oscillatory motion than the nose temperatures.

Piper, W. D. and DeMeritte, F. J.: Summary of the NOL Investigations to Date of the Aerodynamic Characteristics of the Navy Low Drag Bomb.(U) NavOrd Report 5679. CONFIDENTIAL

Abstract: This report summarizes the available aerodynamic data on the Navy low drag bomb. The data were obtained from a series of investigations conducted by NOL personnel in the NOL Supersonic Tunnel No. 1, the NOL Aerodynamics Range No. 1, the NOL Pressurized Ballistics Range, the DTMB 8 x 10-foot Subsonic Wind Tunnel, and Cornell Aeronautical Institute 3 x 4-foot Transonic Wind Tunnel. The aerodynamic data are presented as functions of angle of attack at Mach numbers of 0.80, 1.56, and 2.16, and as functions of Mach number for Mach numbers between 0.80 and 2.16.

Piper, W. D.: Subsonic Static Stability and Damping Pitch Characteristics of the LULU Depth Bomb.(U) NavOrd Report 5782. CONFIDENTIAL

Abstract: This report presents the results of an investigation in the NOL Supersonic Tunnel to measure the normal force, the pitching moment, axial force, and pitch damping moment of the LULU depth bomb. These data were obtained at subsonic Mach numbers from $M = 0.30$ to $M - 0.90$.

Powers, John O. and Krahn, Edgar: Heat Transfer in Dissociated Air by a Two-Thickness Integral Method. Part I: Stagnation Point Heat Transfer. NavOrd Report 6673. UNCLASSIFIED

Abstract: A theoretical investigation of the compressible laminar boundary layer including the effects of dissociated air in equilibrium has been conducted by a two-thickness integral method. The method has been used for determining stagnation point heat-transfer and boundary-layer characteristics at pressures near one atmosphere and for wall and stream temperatures ranging from 400°R to 3,000°R and 600°R to 14,000°R respectively. Comparison with the theory of Fay and Riddel indicates agreement for stream temperatures up to 10,000°R. Differences, which increase with increasing temperature, approach 30 percent at a temperature of 14,000°R. The stagnation point results imply that the general application of the present method to blunt bodies of revolution is valid and also indicate areas of potential refinement.

Rast, J. J.: The Design of Flat-Scored High-Pressure Diaphragms for Use in Shock Tunnels and Gas Guns. NavOrd Report 6865. UNCLASSIFIED

Abstract: An empirical design curve for flat-scored metal diaphragms is presented, which predicts burst pressures up to 40,000 psi. Also discussed are methods of holding the diaphragms and materials used in their fabrication.

Redman, E. J.: Wind-Tunnel Measurements of Total-Pressure Recovery, Capture-Area Ratio, and External Cowl Pressures for Six SSGM (Mach 5) Inlet-Diffuser Configurations at Mach Numbers from 2.49 to 4.83.(U) NavOrd Report 6258. CONFIDENTIAL

Abstract: Total-pressure recoveries and capture-area ratios at low angles of attack are tabulated for six isentropic-spike inlet-diffuser configurations at test Mach numbers of 4.12 and 4.83. A second tabulation gives external cowl-pressure distributions at zero angle of attack on four of the above configurations at test Mach numbers ranging from 2.49 to 4.83, and on a conical spike inlet at Mach numbers of 4.13 and 4.83. All configurations have a design Mach number of 5, and were tested in the NOL Supersonic Tunnel. Several plots are included to show characteristics of the data.

Redman, E. J.: Wind-Tunnel Characteristics of Probe Configurations Devised for Use in the Super-Talos Air-Data System. (U) NavOrd Report 6655. CONFIDENTIAL

Abstract: Six cone-cylinder probes and two Pitot probes, all full-scale, were investigated in the NOL Supersonic Tunnel at Mach numbers from 2.76 to 4.12. The cylindrical portion (sting) contained a manifold having sixteen static orifices. Most of the nose cones (40-degree vertex angle) contained a manifold having various arrangements of four or eight static orifices. The variations of pressure in the two manifolds were obtained at angles of attack up to 20 degrees. Limited checks were made on the cylinder manifold for the effects of regulated mass flows exiting from its orifices, and for the effects of simulated downstream pressure-disturbances.

Redman, E. J.: Wind-Tunnel Performance of Eight Types of Subsonic-Exhaust Configurations at Free-Stream Mach Numbers between 2.76 and 4.13(U) NavOrd Report 6697. CONFIDENTIAL

Abstract: Eight exhaust arrangements were mounted successively in a basic model representing an exhaust "island" for use on the Super-Talos missile. Supply pressure, internal static pressure and subsonic Mach number were measured in relation to the weight flows passed through the configurations at free-stream Mach numbers between 2.76 and 4.13. The tests were conducted in the NOL Supersonic Tunnel with exhaust flows comparable in magnitude to the free-stream flow through equivalent areas. The results are presented graphically and the configurations are compared in their performance relative to an isentropic-flow channel.

Redman, E. J.: Wind-Tunnel Measurements of "Bridging" Effects on Nine Inlet-Diffuser Spikes at a Nominal Mach Number of 4.84. (U) NavOrd Report 6773. CONFIDENTIAL

Abstract: Pressure-recovery and flow-capture measurements were made and spark-shadowgraph pictures were taken in the NOL Supersonic Tunnel for an inlet diffuser using interchangeable spikes. These modified spikes were investigated in connection with the performance losses associated with "bridging" on the SSGM (Mach 5) diffuser. The tests were made at a nominal Mach number of 4.84 for angles of attack from 0 to 6 degrees and supply pressures of one and two atmospheres. Tabulated results and several auxiliary figures are presented.

Redman, E. J.: Wind-Tunnel Static-Stability and Control Tests on the APL Research Configuration at Mach Numbers of 2.54 and 3.51. (U) NavWeps Report 6864. CONFIDENTIAL

Abstract: Static-stability and control characteristics of the APL research configuration were investigated in the NOL Supersonic Tunnel at Mach numbers of 2.54 and 3.51. The configuration is a winged vehicle of high fineness-ratio intended to have minimum aerodynamic pitch-roll-yaw coupling. Data were obtained for pitch angles between -4 and +20 degrees, together with roll angles mainly from -20 to +20 degrees. Test results are presented in tabular form without analysis.

Redman, E. J. and Liccini, L. L.: Normal Forces and Pitching Moments obtained from a Water-Cooled Internal Strain-Gage Balance at Mach Numbers 5 to 8, using the EX 8-0 (20 mm projectile) Configuration. (U) NavOrd Report 6303. CONFIDENTIAL

Abstract: Normal forces and pitching moments were obtained at Mach numbers 5 to 8 and over an angle of attack range of -3 to +12 degrees, using a water-cooled internal strain-gage balance of NOL design. A 20-mm projectile model (EX 8-0: 1.44 scale) was used in these tests, which were conducted in the NOL hypersonic tunnel. These measurements were intended mainly to provide an immediate criterion for estimating the performance of the balance, and are shown to join smoothly with data available for the EX 8-0 configuration at lower Mach numbers.

Schermerhorn, V., Ceretta, P. A., and DeMeritte, F. J.: Wind-Tunnel Tests of the Mark-28 Bomb and Practice Bomb 104. (U) NavWeps Report 7377. CONFIDENTIAL RESTRICTED DATA

Abstract: CONFIDENTIAL RESTRICTED DATA

Schermerhorn, V. and DeMeritte, F. J.: Pitch Damping Tests of Proposed Polaris Exit and Re-Entry StageConfigurations. (U). NavOrd Report 6846. CONFIDENTIAL

Abstract: This report presents the results of an investigation in the NOL Supersonic Tunnel to measure the pitch damping moments on proposed exit and re-entry stage versions of the Polaris missile.

Schermerhorn, V. and DeMeritte, F. J.: Pitch Damping Tests of the Pershing Re-Entry Body. (U) NavOrd Report 6896. CONFIDENTIAL

Abstract: This report presents the results of an investigation in the NOL Supersonic Tunnel to measure the pitch damping of the Pershing re-entry body. These data were obtained at Mach numbers 1.76, 2.03, 2.28, 3.51, 4.12 and 4.82.

Schermerhorn, V. and DeMeritte, F. J.: Pitch Damping Tests of the NOTS Experimental Rocket EV II. (U) NavOrd Report 7282. CONFIDENTIAL

Abstract: This report presents the results of an investigation in the NOL Supersonic Tunnel to measure the pitch damping coefficients of the NOTS Experimental Rocket EV II. These data were obtained at Mach numbers of 0.79, 1.75, 2.27, 3.49, and 4.10.

Schermerhorn, V. and DeMeritte, F. J.: Wind-Tunnel Tests of the Navy Low-Drag Bomb at Angles of Attack up to 70 Degrees. NavWeps Report 7291. UNCLASSIFIED

Abstract: This report presents the results of an investigation in the NOL Supersonic Tunnel to measure the static stability and drag of the Navy low-drag bomb at angles of attack up to 70°. These data were obtained at Mach numbers of 0.40, 0.60, 0.80, 1.53, 1.76, and 2.03.

Schermerhorn, V. L. and Lehnert, R.: Wake Investigation on Sharp and Blunt Nose Cones at Supersonic Speeds. NavOrd Report 5668. UNCLASSIFIED

Abstract: See Lehnert, R. and Schermerhorn, V.L., page 27.

Schermerhorn, V. L., and Shantz, Irving: Wind-Tunnel Static and Dynamic Stability Measurements for a Series of Bluff-Body Shapes at Mach Numbers 0.86 and 1.56.(U) NavOrd Report 5691.

Abstract: See Shantz, Irving and Schermerhorn, V. L., page

Schuman, Elias V.: Heat Capabilities of Selected Isotropic Materials.(U) NOLTR 61-88. CONFIDENTIAL

Abstract: This report presents the results of stagnation point heating calculations of possible re-entry bodies for five isotropic materials. The calculations simulate re-entry flights on a hemispherical, 12-inch diameter nose cone under a broad variation in loading factor and range. The method used is outlined and thermal performance curves obtained in terms of shield weight required for each material.

Seigel, A. E. and Slawsky, Z. I.: A Two-Stage Driver for Shocktubes and Shock Tunnels. NavOrd Report 5669. UNCLASSIFIED

Abstract: This report discusses a method of improving the performance of the driver for shocktubes and shocktube wind tunnels. The basic principle is the use of a chemical reaction (oxygen plus hydrogen added to helium) to produce a low-molecular weight, high-temperature gas and then a shock to further compress and heat this gas. This two-stage scheme has previously been presented in NavOrd Report 4345 where it was applied to high-speed guns. Here the performance of a shocktube and shocktube wind tunnel using such an improved driver is described.

Shantz, I., Groves, R. T. and DeMeritte, F.J.: Ballistic Missile Re-Entry Shapes.(U) NavOrd Report 6066. CONFIDENTIAL

Abstract: Free-oscillation damping tests of the re-entry configuration of Polaris that were conducted previously at NOL have shown the existence of a dynamic instability in Mach number region from 0.7 to 0.9 (the upper Mach number limit of the NOL subsonic nozzle). This report presents the results of tests made in the NOL Aeroballistic Tunnels to measure the damping moment coefficients of the Polaris re-entry body. Also included are possible modifications to the configuration in an attempt to improve the dynamic characteristics at subsonic and transonic speeds. These tests were conducted in the Mach number range of 0.85 to 0.88.

Shantz, I. and DeMeritte, F. J.: Summary of the Dynamic Stability Wind-Tunnel Tests at NOL in Support of the Polaris Mark I. (U) NavOrd Report 6802. CONFIDENTIAL

Abstract: This report presents a summary of the wind-tunnel tests to examine the dynamic stability problems associated with the Polaris type re-entry configuration. The stability problems are brought about by flow separation at transonic speeds caused by blunt nose. This separation causes a small angle oscillation (limit cycle) of the body while passing through the transonic speed range. Limited pitch damping data are presented on several selected configurations. Included in this report are several configurational changes which solve the limit cycle problem. These data were obtained in the NOL Supersonic Tunnel.

Shantz, I. and DeMeritte, F. J.: Limited Wind-Tunnel Tests of the MK 89 Practice Bomb. NavOrd Report 6852. UNCLASSIFIED

Abstract: See DeMeritte, F. J.and Shantz, I., page 10.

Shantz, I. and DeMeritte, F. J.: Pitch Damping Tests of Two Proposed Polaris Re-Entry Bodies. (U) NavOrd Report 6855. CONFIDENTIAL

Abstract: This report presents the results of an investigation in the NOL supersonic tunnel to measure the pitch damping moments of two proposed Polaris re-entry body configurations.

Shantz, I., and Schermerhorn, V. L.: Wind-Tunnel Static and Dynamic Stability Measurements for a Series of Bluff-Body Shapes at Mach Numbers 0.86 and 1.56. (U) NavOrd Report 5691. CONFIDENTIAL

Abstract: Several configurations of bluff-bomb shapes were tested at Mach numbers 0.86 and 1.56. These configurations came from two general classes of shapes, the "dumbbell" type and the faired-body, fin-base plate type. Primary emphasis was placed on obtaining adequate aerodynamic stability with minimum span tail stabilizers. Static stability and pitch damping measurements were made for a number of configurations.

Shen, S. F.: Some Considerations of the Laminar Stability of Incompressible Time-Dependent Basic Flows. NavOrd Report 6654. UNCLASSIFIED

Abstract: The concept of "momentary stability" is proposed as a stability criterion for infinitesimal disturbances in a time-dependent basic flow, and is said to exist when the ratio of kinetic energy of the disturbances to the kinetic energy of the basic flows tends to decrease instantaneously. Stability phenomena for unsteady basic flows are analyzed for the case of the inviscid limit. For finite Reynolds numbers it is shown that stability calculations based on instantaneous profiles are valid only for extremely small accelerations or decelerations, and generally the neutral curve so obtained has little significance. In general, flows are greatly stabilized by acceleration and greatly destabilized by deceleration.

Smith, Helen A.: Naval Ordnance Laboratory NavOrd Reports published by the Aeroballistics Research Area, 1 January 1957 through 31 December 1959.(U) NavOrd Report 6818. CONFIDENTIAL

Abstract: Titles and abstracts of Naval Ordnance Laboratory NavOrd Reports published by the Aeroballistic Research Area from 1 January 1957 through 31 December 1959 are presented.

Steinle, W. C. and DeMeritte, F. J.: Total Pressure Recovery of Talos 6b2 and 6bWIA Diffuser at Supersonic Speeds.(U) NavOrd Report 6833. CONFIDENTIAL

Abstract: Wind-Tunnel pressure tests have been conducted of a one-third scale Talos 6b2 and 6b1WIA diffuser. These tests were run in the NOL Supersonic Tunnel at Mach numbers of 2.77, 3.22, 4.11 and 4.84 to evaluate a series of innerbody-cowl configurations that would permit selection of the optimum inlet for the missile.

Steinle, W. C. and DeMeritte, F. J.: Total Pressure Recovery of the Talos 6b2 Diffuser at Supersonic Speeds.(U) NavOrd Report 6031. CONFIDENTIAL

Abstract: Wind-tunnel pressure tests on a one-third scale Talos 6b2 diffuser have been conducted in the NOL Supersonic Tunnel at Mach numbers of 2.77, 3.22, 4.11 and 4.84 to evaluate a series of innerbody-cowl configurations that would permit selection of the optimum inlet for the missile.

Van Tuyl, A.: The Use of Rational Approximations in the Calculation of Flows with Detached Shocks. NavOrd Report 6679. UNCLASSIFIED

Abstract: Calculations by M. D. Van Dyke indicate that the Taylor series for the stream function behind an axially symmetric bow shock in the neighborhood of the nose does not converge at the body. In the present report, it is shown that certain sequences of Pade fractions obtained from the Taylor series seem to converge at the body, and can be used for calculation of the flow. Calculations are carried out for a paraboloidal shock in a perfect gas with free stream Mach number $M = 2$ and $\gamma = 7/5$. The results are in good agreement with numerical calculations.

Volz, William C.: Normal Forces and Pitching Moments of Nike-Zeus Jethead at Mach Numbers 8.04 and 10.15. (U) NavWeps Report 7370. CONFIDENTIAL

Abstract: The normal-force and pitching-moment coefficients for the Nike-Zeus jethead were obtained as a result of wind-tunnel tests at Mach numbers 8,04 and 10.15 in the Hypersonic Tunnel. These tests were made for an angle-of-attack of -3° to $+20^\circ$, canard deflections of 0°, 17.5°, and 35°, and Reynolds numbers per foot, based on free-stream conditions of 2.46 and 1.32×10^6.

Volz, William C.: Normal Forces and Pitching Moments of EV-II at Mach Number 7.90. (U) NOLTR 61-69. CONFIDENTIAL

Abstract: Normal-force and pitching-moment coefficients for the EV-II were obtained as a result of wind tunnel tests at a Mach number of 7.90 in the Hypersonic Tunnel No. 4. The test Reynolds number per foot, based on free-stream conditions, was 0.98×10^6.

Wachsler, E. and Gauzza, H. J.: Pressure Tests of Several Diffuser-Wing-Body Combinations of a 0.0933 Scale SSGM. (U) NavOrd Report 6179. CONFIDENTIAL

Abstract: Pressure tests of several 0.0933 scale SSGM (surface

to-surface guided missile) diffusers alone and in combination with wing-body configurations have been conducted in the NOL Supersonic Tunnel at nominal Mach numbers of 3.24, 4.10 and 4.80, at angles of attack from -2 to + 10 degrees, and at angles of sideslip of 0 and +3 degrees. Schlieren photographs were taken during the tests to obtain qualitative information on the flow characteristics.

Waser, R. H., and Dawson, V.C.D. and Noonan, B. J.: Experimental Stress Analysis of a Spherical Combustion Chamber. NavWeps Report 7319. UNCLASSIFIED

<u>Abstract:</u> See Dawson, V.C.D., Noonan, B.J. and Waser, R.H., page 8.

Winkler, Eva M. and Cha, Moon H.: Investigation of Flat Plate Hypersonic Turbulent Boundary Layers with Heat Transfer at a Mach Number of 5.2. (U) NavOrd Report 6631. UNCLASSIFIED

<u>Abstract:</u> Naturally turbulent boundary layers on a flat plate have been investigated at several distances from the leading edge of the plate for three rates of steady-state heat transfer to the surface. The results support the validity of Colburn's version of Reynolds analogy for all conditions of the present experiments. For a fixed value of the momentum thickness Reynolds number, the skin-friction coefficient was found to decrease with increasing rate of heat transfer to the surface. A simple relation has been devised which describes closely the variation of the skin-friction coefficient with Mach number, heat-transfer rate, and momentum thickness Reynolds number.

Wood, E. C.: Static Stability and Control Measurements on a 1/15-Scale Model of the Talos 6b2 Missile at Supersonic Speeds. (U) NavOrd Report 6899. CONFIDENTIAL

<u>Abstract:</u> This report presents the results of an investigation in the NOL Supersonic Tunnel No. 1 to measure the static stability and control characteristics of the 1/15-scale Talos 6b2 missile. These data were obtained at Mach numbers 2.48, 2.76, 3.24, and 4.10.

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